2.3 Activities, Accomplishments, and Issues

K. R. Price

This section describes DOE's progress in meeting its mission at the Hanford Site. Section 2.2, "Compliance Status," described activities relating to compliance with regulations. This section describes other, major, ongoing activities. Ongoing compliance self-assessments, knowledge gained in implementing Tri-Party Agreement (Ecology et al. 1998) milestones, and communications with stakeholders continue to identify environmental compliance issues. Relevant issues are discussed openly with the regulators and with the public to ensure that environmental compliance issues are resolved.

2.3.1 Hanford Federal Facility Agreement and Consent Order

Highlights of accomplishments (not documents or publications), with the associated Tri-Party Agreement milestone numbers, include the following:

- submitted Gable Mountain/B Pond and Ditch Cooling Water Group Work Plan (M-13-20)
- submitted Chemical Sewer Group Work Plan (M-13-21)
- submitted U Pond/Z Ditches Cooling Water Group Work Plan (M-13-22)
- completed all remaining 100 Area Operable Unit Pre-Record of Decision Site Investigations Under Approved Work Plan Schedules (100-KR-2, 100-KR-3, 100-FR-2, 100-HR-2, 100-IU-2, and 100-IU-6) (M-15-00A)
- completed all 300 Area Operable Unit Pre-Record of Decision Site Investigation Under Approved Work Plan Schedules (M-15-00B)
- submitted 300-FF-2 Focus Feasibility Study and Proposed Plan for Regulator Review (M-15-23B)
- initiated remedial action for 100-HR-1 Operable Unit (M-16-26A)
- completed Environmental Restoration Disposal Facility Cells 3 and 4 to Accept Remediation Waste (M-16-92B)
- initiated tank pumping for T-104, T-110, SX-104, SX-106, S-102, S-106, and S-103 meeting the enforceable commitments in the decree order
- resolved the criticality safety issues (M-40-12)
- started construction upgrades in a second tank farm (M-43-13)
- completed the Waste Information Requirements Document cycle (issue to Ecology, finalize, characterize, and issue reports) (M-44)
- completed sluicing retrieval of tank 241-C-106 sludge (M-45.03)
- completed updates for reports supporting M-45
- completed double-shell tank space evaluation (M-46)
- submitted revised Canister Storage Facility Part A Dangerous Waste Permit Application (M-90-12)

- submitted 105-B Hazards Assessment and Characterization Report to EPA (M-93-04)
- completed cross-site transfers via the new cross-site transfer system
- completed the mitigation of 241-SY-101 Waste Tank.

Since this report was issued last year, negotiated changes to the Tri-Party Agreement established 29 new enforceable milestones. A summary of the significant changes is given in the following sections.

2.3.1.1 Waste Management

There were three change requests related to waste management approved during 1999.

Milestone M-26-01 is an annually occurring milestone that requires the submittal of a report dealing with Land Disposal Restrictions wastes at the Hanford Site. On June 3, 1999, the Washington State Department of Ecology issued a notice of correction regarding the Land Disposal Restrictions report. Issues arising from the notice of correction became the subject of dispute resolution procedures contained within the Tri-Party Agreement. To avoid producing a year 2000 Land Disposal Restrictions report that may not have been satisfactory to both parties, the due date for the year 2000 report was extended from April 30, 2000, to July 31, 2000.

RCRA interim status compliance upgrades to the 219-S Waste Handling Facility encountered delays due to resolution of polychlorinated biphenyl and completion of requirements. The final due date for completion of the upgrades was extended from April 30, 1999, to June 30, 1999.

Milestone M-32-03-T06 was originally intended to include major capital upgrades to the T Plant canyon facility tank system (building 221-T). These upgrades would ensure that decontamination operations would be in accordance with the regulatory standards for secondary containment and leak detection. Subsequent studies concluded that the best option was to move future decontamination activities from the T Plant canyon to nearby buildings 2706-T and 2706-TA and to eliminate the use of the 221-T storage tanks. The scope of the milestone was modified to delete upgrades to the T Plant canyon tank system and increase the scope of work for buildings 2706-T and 2706-TA by providing a new, compliant, dangerous waste tank system.

2.3.1.2 Environmental Restoration

There were six change requests related to environmental restoration approved during 1999.

DOE's environmental restoration program began assessing the contamination at ~700 waste sites, within 23 operable units, located in the 200-East and 200-West Areas of the Hanford Site. DOE, Washington State Department of Ecology, and EPA worked together to prioritize the assessment of the operable units based on criteria such as potential threats to health and the environment. The initial prioritization is reflected in milestones that establish dates for developing assessment work plans, characterization, and evaluating cleanup alternatives. The parties agreed to review the prioritization as work progressed to determine if there were any necessary changes to the criteria or ranking process. In July 1999, DOE, Washington State Department of Ecology, and EPA met to reassess operable unit prioritization needs. As a result of this reassessment Milestone M-13-23 was reassigned from the 200-PW-2 Operable Unit to the 200-TW-1 Operable Unit and the date was extended from April 30, 2000, to August 31, 2000. Milestone M-13-24 was reassigned from the 200-PW-4 Operable Unit to the 200-TW-2 Operable Unit with no change to the due date. Two new milestones were created, M-13-25 requiring the submittal of the 200-PW-2 Operable Unit work plan by December 31, 2000, and M-13-26 requiring the submittal of the 200-PW-4 Operable Unit work plan by June 30, 2001.

Two sets of changes were approved to groundwater sampling and analysis plans for the 100-FR-3 and 100-BC-5 Operable Units. These changes continue the established trend to produce a more integrated and cost effective monitoring system. Any resulting changes in samples, analytes, and frequency of sampling are expected to result in minimal or negligible loss of relevant information.

A number of unanticipated issues occurred that affected the sequence of work and the duration of remedial activities at several 300-FF-1 Operable Unit waste sites. These events necessitated changes to the controlling milestone, M-16-03D. The original milestone was deleted and two new milestones M-16-03E and M-16-03F were added to the Tri-Party Agreement addressing the remediation of waste sites in the 300-FF-1 Operable Unit.

The completion date for remediation and backfill of 19 liquid waste sites in the 100-BC-1 and 100-BC-2 Operable Units had to be extended by 6 months. This extension became necessary due to the discovery of chromium and additional contaminated material in the 116-C-5 waste site. Additional sampling requirements and the discovery of additional plumes affected the completion date resulting in the 6-month extension of milestone M-16-08B.

Each year the number and location of RCRA monitoring wells are mutually determined by the DOE and Washington State Department of Ecology. For calendar year 1999, it was determined that eight new wells were necessary and these were added to the Tri-Party Agreement under five new milestones.

2.3.1.3 Office of River Protection

There were four change requests related to the Office of River Protection approved during 1999.

During Tri-Party Agreement negotiations in 1993, it was recognized that the Grout Facility, while in a standby condition, could be restarted. Therefore, interim milestone M-32-08 and milestone M-32-08-T01 were included in the Tri-Party Agreement to require the completion of an integrity assessment of the Grout tank system prior to processing double-shell tank waste. The decision has since been made that the Grout Facility will not process double-shell tank waste. Therefore, the interim milestone and target date are no longer needed and were deleted from the Tri-Party Agreement.

Because difficulties have delayed the completion of interim stabilization (i.e., removal of liquids) of the single-shell tanks, DOE and Washington State Department of Ecology agreed that the requirements to complete the stabilization should be filed as a consent decree with the United States District Court for the Eastern District of Washington (Consent Decree CT-99-5076-EFS). Consequently, DOE, Washington State Department of Ecology, and EPA agreed to, and then approved, the deletion of the interim stabilization program from the scope of the Tri-Party Agreement.

DOE requested an extension to interim milestone M-45-03A that requires the sluicing retrieval of waste from tank C-106 by October 31, 1997. The extension became necessary when safety issues effected the work. Washington State Department of Ecology denied the request for extension and set conditions and a new date for completion of the work. The Pollution Control Hearings Board subsequently upheld the action by the Washington State Department of Ecology. DOE and Washington State Department of Ecology approved a new milestone date of December 31, 1999.

The 244AR Vault is a multi-cell concrete structure housing four single walled tanks. Early planning for the 244AR Vault was based on the assumption that operations to transfer waste from the vault would eventually restart. Therefore, milestones were established to conduct necessary integrity assessment work. DOE and Washington State Department of Ecology have since agreed that the vault will not be used as a waste transfer facility and should

eventually be closed. DOE and Washington State Department of Ecology approved the deletion of the existing 244AR milestones and established new milestones covering interim stabilization of the vault pending the facility's eventual closure.

2.3.1.4 Facilities Transition

There were three change requests related to facilities transition approved during 1999.

In light of recent decisions and after extensive public involvement, DOE and Washington State Department of Ecology approved two change requests placing the Tri-Party Agreement milestones for the Fast Flux Test Facility in "abeyance" until the Secretary of Energy issues a final decision on whether or not to restart the Fast Flux Test Facility (see Section 2.3.5, "Fast Flux Text Facility," for details regarding recent decisions).

Tank 241-Z-361 is a tank within the Plutonium Finishing Plant and Operable Unit 200-PW-1 that is to be remediated under the authority of CERCLA. Although completion of the usual CERCLA work plan for this operable unit is not planned until the end of calendar year 2001, the resolution of urgent safety issues necessitated early action. DOE and EPA approved commitments to sample, analyze, and provide a recommendation to dispose of sludge from tank 241-Z-361.

Major Milestone M-89-00 required DOE to complete closure of nonpermitted mixed waste units in the 324 Building Radiochemical Engineering Cells, B Cell, D Cell, and High Level Vault. DOE and Washington State Department of Ecology were required to agree on a date for this milestone following Ecology's September 1, 1998, approval of the plan to close 324 Building REC/HLV. Based on the approved closure plan, DOE and Washington State Department of Ecology approved the final due date of October 31, 2005, for Major Milestone M-89-00.

2.3.1.5 Spent Nuclear Fuel

There were two change requests related to spent nuclear fuel approved during 1999.

The K basins are two aging basins within the 100-K Area of the Hanford Site where spent nuclear fuel is stored (see Section 2.3.3, "Spent Nuclear Fuel Project"). In 1998, extensive negotiations took place between DOE, Washington State Department of Ecology, and EPA to establish a schedule for the removal of spent nuclear fuel, debris, sludge, and water from the KE and KW basins. In early 1999, DOE, Washington State Department of Ecology, and EPA approved a Tri-Party Agreement change request establishing a baseline of milestones and target dates.

In February 1999, an internal review found deficiencies in the analytical modeling of possible cask drop accidents in the south loading pit of the KW Basin. These deficiencies in the analytical modeling of the facility structure challenged earlier conclusions about the basins. Assessment of the problem, resolution of the concerns, and implementation of mitigation steps resulted in extension of interim Milestone M-34-14A, "Complete K West Cask Facility modifications" from September 30, 1999, to February 29, 2000.

2.3.2 Pollution Prevention Program

Pollution prevention is DOE's preferred approach to environmental management. The Hanford Site Pollution Prevention Program is an organized and continuing effort to reduce the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes. The program fosters the conservation of resources and energy, the reduction of hazardous substance use, and the prevention or minimization of pollutant releases to all environmental media from all operations and site cleanup activities.

The program is designed to satisfy DOE requirements, executive orders, and federal and state regulations and requirements. In accordance with sound environmental management, preventing pollution through source reduction is the first priority in this program; the second priority is environmentally safe recycling. Waste treatment to reduce quantity, toxicity, or mobility (or a combination of these) will be considered only when source reduction and recycling are not possible or practical. Disposal to the environment is the last option.

Overall responsibility for the Hanford Site Pollution Prevention Program resides with the DOE Richland Operations Office. The office defines overall program requirements that each prime contractor is responsible for meeting.

Hanford Site pollution prevention efforts in 1999 helped to reduce disposal requirements through source reduction and recycling an estimated 2.8 cubic meters (3.7 cubic yards) of radioactive mixed waste, 164 metric tons (362 tons) of RCRA hazardous/dangerous waste, 144 million liters (38 million gallons) of process wastewater, and 5,616 metric tons (12,380 tons) of sanitary waste. Estimated waste disposal cost savings in 1999 exceeded $54 million for these activities. During 1999, the Hanford Site recycled 476 metric tons (1,050 tons) of paper products, 529 metric tons (1,170 tons) of various metals, and 11 metric tons (24 tons) of tires.

2.3.3 Spent Nuclear Fuel Project

The Spent Nuclear Fuel Project was established in February 1994 to provide safe, economic, and environmentally sound management of Hanford Site spent nuclear fuel in a manner that readies it for final disposition. DOE strategic planning recommends that the fuel stored in K basins and other spent nuclear fuel on the site and throughout the DOE complex be placed in a geologic repository for final disposition.

Through 1999, the project continued to make progress on its accelerated strategy for moving the wet-stored K Basin fuel away from the Columbia River and into the Canister Storage Building. The 40-year-old K basins are used to store 2,100 metric tons (2,300 tons) of N Reactor irradiated fuel and a small quantity of slightly irradiated single-pass reactor fuel. The cladding on much of the fuel was damaged, allowing the fuel to corrode and degrade during storage underwater. The reactor fuel eventually will be removed from underwater storage in the K basins and placed in dry interim storage in the 200-East Area. Prior to interim storage, the fuel will be cleaned to remove corrosion products and particulates, packaged into fuel storage containers called Multi-Canister Overpacks, and vacuum processed to remove the water from the packaged fuel. The vacuum processing will be done at the cold Vacuum Drying Facility that has been completed in the 100-K Area. Following the drying process, the fuel will be transported to the Canister Storage Building that has been constructed in the 200-East Area (see Figure 1.0.2). The Multi-Canister Overpacks will be sealed, and the fuel will be maintained in storage pending a decision by the Secretary of Energy on its final disposition. If necessary, the fuel could remain in dry storage for up to 40 years. This strategy supports completion of fuel removal from the K basins by the Tri-Party Agreement date of July 2004. An Operational Readiness Review is scheduled to take place during the summer of 2000 to support startup of the new fuel handling systems in the 105-KW Basin, fuel conditioning processes in the Cold Vacuum Drying Facility, and storage operations in the Canister Storage Building. This review is expected to determine that the facilities are ready to start operations, so fuel removal from the KW Basin can begin by November 30, 2000.

Fuel corrosion and fuel handling operations have led to the accumulation of ~50 cubic meters of sludge and corrosion products in fuel storage canisters and on the floors of the K basins. The majority of the sludge is in the KE Basin. Following the removal of the spent nuclear fuel from the K basins, activities will be undertaken to remove the sludge from the basins by August 2004.

Debris, empty fuel canisters, and water remaining in the K basins will also be removed, treated as necessary, and disposed. The debris will be disposed at the Environmental Restoration Disposal Facility on the Hanford Site to the extent possible. If the debris is such that it does not meet the waste criteria to be accepted by the Environmental Restoration Disposal Facility, then it will be transferred to an existing permitted waste management facility. The water will be treated at the Hanford Site 200 Areas Effluent Treatment Facility and will be disposed of onsite. The K basins then will be prepared for interim stabilization, pending final remediation.

The Spent Nuclear Fuel Project also specifies that other spent nuclear fuel stored on the Hanford Site will be relocated to the 200-East Area Interim Storage Area or to the Canister Storage Building. Other stored spent nuclear fuel can be found at

- Fast Flux Test Facility fuel in the 400 Area
- Training, Research, and Isotope Production General Atomics fuel in the 400 Area
- Shippingport, Pennsylvania, reactor fuel at T Plant in the 200-West Area
- miscellaneous special case and research reactor fuels in the 324, 325, and 327 buildings in the 300 Area.

A CERCLA Record of Decision for K Basins cleanup (99-SFD-190) was signed by DOE, Washington State Department of Ecology, and EPA. In addition, some of the major accomplishments for calendar year 1999 were

- completed construction of the 105-KW Basin fuel retrieval system and integrated water treatment system
- completed construction and installation of the process equipment in two bays of the Cold Vacuum Drying Facility
- completed installation of the sample station at the Canister Storage Building
- completed placement of 220 storage tubes at the Canister Storage Building
- awarded a contract for the production of the Multi-Canister Overpacks and began fabrication
- began onsite fabrication of fuel and scrap baskets
- prepared extensive safety analysis documentation.

2.3.4 River Corridor Project

The mission of the River Corridor Project is to deactivate contaminated facilities in preparation for decontamination and decommissioning. The project also provides for safe and secure storage of special nuclear material, nuclear material, and nuclear fuel until these materials can be transferred to another facility, sold, or otherwise dispositioned.

Within the River Corridor Project are multiple subprojects and facilities which are discussed in the following sections.

2.3.4.1 Accelerated Deactivation Project

The mission of the Accelerated Deactivation Project is to complete facility deactivation and closure activities while maintaining the facilities in a safe and compliant status, until turnover to the Environmental Restoration Program.

300 Area Fuel Supply Shutdown Subproject. Facilities managed under the Accelerated

Deactivation Project include those associated with the 300 Area Fuel Supply Shutdown subproject. The fuel supply subproject includes buildings dating back to 1943 that housed manufacturing equipment to produce fuel for Hanford Site reactors. These processing operations were discontinued in 1987 when N Reactor was shut down and placed in a standby mode.

During 1999, RCRA treatment, storage, and disposal unit closure activities were performed for the 300 Area Waste Acid Treatment System. As part of this effort, the Washington State Department of Ecology approved the decontamination and inspection activities associated with the treatment, storage, and disposal unit closure campaign.

2.3.4.2 324 and 327 Facilities Deactivation Project

Construction of the 324 and 327 buildings was completed and operations were initiated in 1966 and 1953, respectively. These buildings house hot cells that were used for radiological research and development work. Both facilities were transferred to Fluor Hanford, Inc. in 1996 for deactivation and closure.

During 1999, the Accelerated Deactivation Project accomplished the following tasks:

- performed 324 Building B Cell equipment and rack (storage rack) size reduction activities. These activities included placement of debris into containers that will be used for transport to Hanford waste management storage facilities.
- collected and containerized dispersible materials from the 324 Building B Cell floor
- completed and submitted updated safety documentation for both the 324 and 327 buildings to DOE Richland Operations Office for approval
- packaged and shipped 23 drums (containing 96 legacy transuranic and low-level waste "buckets" from the 327 Building hot cells) to safe storage in the 200-West Area, which exceeded the goal of 20 drums. Twelve additional drums (containing 51 hot cell buckets) associated with the spent nuclear fuel program, were also packaged and shipped.
- developed and submitted the 300 Area Special-Case Waste Project Management Plan (HNF-5068) to the DOE Richland Operations Office ahead of schedule, which provides an opportunity for early completion of the Tri-Party Agreement Milestones M-92-13 and M-92-14.

2.3.4.3 300 Area Treated Effluent Disposal Facility

Industrial wastewater generated throughout the Hanford Site is accepted and treated in the 300 Area Treated Effluent Disposal Facility. Laboratories, research facilities, office buildings, and former fuel fabrication facilities in the 300 Area constitute the primary sources of wastewater. The wastewater consists of once-through cooling water, steam condensate, and other industrial wastewaters. The facility began operation in December 1994.

This facility is designed for continuous receipt of wastewater, with a storage capacity of up to 5 days at the design flow rate of 1,100 liters per minute (300 gallons per minute). The treatment process includes iron coprecipitation to remove heavy metals, ion exchange to remove mercury, and ultraviolet light/hydrogen peroxide oxidation to destroy organics and cyanide. Sludge from the iron coprecipitation process is dewatered and used for backfill in the low-level waste burial grounds. The treated liquid effluent is monitored and discharged through an outfall to the Columbia River under a National Pollutant Discharge Elimination System permit No. WA 002591-7. The permit was revised in 1999 to modify discharge limits and to allow for dangerous waste treatment in accordance with state dangerous

waste regulations. However, treatment of dangerous wastes has not been implemented and there is no current schedule for treatment to begin. Capability exists to divert the treated effluent to holding tanks before discharge, if needed, until a determination can be made for final disposal based on sampling. In 1999, ~223 million liters (59 million gallons) of wastewater were treated.

2.3.4.4 Plutonium Finishing Plant

In 1949, the Plutonium Finishing Plant began to process plutonium nitrate solutions into metallic forms for shipment to nuclear weapons production facilities. Operation of this plant continued into the late 1980s. In 1996, DOE issued a shutdown order for the plant, authorizing deactivation and transition of the plutonium processing portions of the facility in preparation for decommissioning. The mission is to stabilize, repackage, immobilize and/or properly dispose of plutonium-bearing materials in the plant; to deactivate the processing facilities; and to provide for the safe and secure storage of nuclear materials until final disposition.

Significant accomplishments achieved at the Plutonium Finishing Plant during 1999 include the following:

- processed 150 items of oxides and sludge in the muffle furnaces—40 more than targeted
- installed three more furnaces to increase plutonium stabilization capacity
- restarted a prototype denitration calciner to stabilize plutonium solutions
- completed design for a new, long-term technology for stabilizing solutions, the magnesium hydroxide precipitation process, which is scheduled to become operational in mid-2000
- determined stabilization plans for the remaining plutonium-bearing materials including metals, polycubes, and residues left from processing.

In addition, the long-range project plan for the plant—the Integrated Project Management Plan (HNF-3617, Rev. 0)—was revamped by a multidisciplinary panel of experts from across the DOE complex to determine ways to accelerate work at the Plutonium Finishing Plant. The new plan is expected to save $1.2 billion by accelerating stabilization and deactivation of the plant and shorten the timeline by 22 years.

On February 1, 2000, Westinghouse Safety Management Solutions, a new technical and management team, took over management of the Plutonium Finishing Plant under Fluor Hanford, Inc. The new team, which brings a depth of relevant experience in plutonium stabilization from other DOE sites, will provide new perspectives and innovation to further accelerate work at the plant.

2.3.4.5 Plutonium-Uranium Extraction Plant

The Plutonium-Uranium Extraction Plant represents one of the Hanford Site's earliest successes to identify innovative ways to greatly accelerate facility deactivation, through information sharing, technology, and by working closely with regulators. The plant was deactivated 14 months ahead of schedule, saving $75 million. In September 1999, the plant was transferred to Bechtel Hanford, Inc., the Hanford Site environmental restoration contractor. Bechtel Hanford, Inc. will maintain the plant in a surveillance and maintenance phase until disposition is determined. Before deactivation, the plant required ~$35 million annually to maintain it safely in a standby condition. It now requires less than $1 million a year to be safely maintained in the surveillance and maintenance mode.

2.3.4.6 Waste Encapsulation and Storage Facility

The mission of the Waste Encapsulation and Storage Facility project is to provide safe interim

storage of encapsulated radioactive cesium and strontium. The facility was initially constructed as a portion of the B Plant complex and began service in 1974. In 1998, B Plant was deactivated and disconnected from the Waste Encapsulation and Storage Facility. There are currently 601 strontium fluoride capsules and 1,335 cesium chloride capsules stored at the facility. DOE applied for a Part A (Form 3) permit for dangerous waste storage and is awaiting approval from the Washington State Department of Ecology. The capsules will be stored at Waste Encapsulation and Storage Facility until 2013. Beginning in 2013, the capsules will be shipped to the vitrification plant in preparation for high-level waste vitrification. The final capsule shipment is scheduled for 2017.

2.3.5 Fast Flux Test Facility

The Fast Flux Test Facility, a 400-MW thermal, liquid metal cooled reactor, located in the 400 Area, was built in the late 1970s to test plant equipment and fuel for the Liquid Metal Fast Breeder Reactor Program. Although the facility is not a breeder reactor, this program demonstrated the technology of commercial breeder reactors. The Fast Flux Test Facility operated from April 1982 to April 1992, during which time it successfully tested advanced nuclear fuels, materials, and safety designs and also produced a variety of different isotopes for medical research.

The reactor has been in a hot-standby condition since December 1993. In November 1995, DOE decided to limit deactivation work at the Fast Flux Test Facility to those activities that would not prohibit a return to service while DOE studied the facility's capability to produce tritium and medical isotopes. The fuel was removed from the reactor vessel, and fuel assemblies (sealed metal tubes that hold fuel pellets) were contained in two fuel storage vessels and in aboveground, dry storage casks. Of the facility's 100 plant systems, 23 are deactivated. The facility continues to be maintained in a standby mode in accordance with state and federal requirements.

On December 22, 1998, the Secretary of Energy announced the decision to remove the Fast Flux Test Facility from consideration as a tritium supply source. However, DOE will investigate further the facility's potential role in the department's national nuclear technology infrastructure. In May 1999, after careful consideration of the recommendations from the Nuclear Energy Research Advisory Committee and other analyses, the Secretary concluded that the facility could possibly serve a valuable science and research role. As such, the Secretary asked that a program plan be developed that clearly defines the potential use of the facility and the roles and responsibilities of potential users.

In July 1999, following a review of the program plan, the Nuclear Energy Research Advisory Committee voted 19 to 2, in favor of a resolution recommending DOE proceed toward a Record of Decision on the Fast Flux Test Facility. The committee further recommended that a nonproliferation policy review, cost evaluation, and mission assessment be conducted to inform the Record of Decision. The committee also recommended that a comprehensive research and development plan be prepared under its oversight and that the plan include the Fast Flux Test Facility.

Based on the program plan and the Nuclear Energy Research Advisory Committee recommendations, the Secretary announced on August 18, 1999, that the department would initiate a *National Environmental Policy Act* review of the environmental impacts associated with the restart and operation of the Fast Flux Test Facility as a nuclear research and medical isotope production facility. The results from the *National Environmental Policy Act* review would inform a Record of Decision for the establishment of either a restart project or a deactivation project for the Fast Flux Test Facility.

2.3.5.1 The Decision Process

DOE is preparing a programmatic environmental impact statement that will evaluate options for managing DOE's nuclear research infrastructure to meet projected national research and development needs. These needs include a reliable supply of isotopes and irradiation services for medicine, industry, research, and space exploration. DOE's nuclear facility infrastructure is diminishing while the demand for steady-state neutron sources continues to increase. Presently, DOE does not have sufficient neutron sources to meet its projected irradiation needs for medical isotope production, plutonium-238 production for future space exploration missions, and nuclear research and development. To address this neutron source deficiency, the programmatic environmental impact statement will evaluate a range of options including the use of existing operating facilities, the restart and operation of the Fast Flux Test Facility, and the construction of entirely new facilities. The options to be analyzed also include making no changes to DOE's existing facilities and permanently deactivating the Fast Flux Test Facility. No preferred alternative will be identified in the draft programmatic environmental impact statement.

The programmatic environmental impact statement, scheduled for completion in November 2000, will be supported by a comprehensive research and development plan developed under the oversight of the Nuclear Energy Research Advisory Committee and nonproliferation and cost analyses. In December 2000, DOE plans to issue a Secretarial Record of Decision, which will be informed by the results from the programmatic environmental impact statement, nonproliferation and cost analyses, a Fast Flux Test Facility waste minimization and management plan, and Nuclear Energy Research Advisory Committee reviews.

2.3.6 Advanced Reactors Transition Project

The mission of this project is to transition or convert the Plutonium Recycle Test Reactor facility and other nuclear energy legacy facilities into structures that are in a safe and stable condition. Legacy facilities are those used as part of the former nuclear production and research projects conducted at the Hanford Site. The transition process includes minimum safe surveillance and maintenance activities. Deactivation of legacy facilities also includes the disposition of nonradioactive sodium and sodium-potassium alloy.

At the Plutonium Recycle Test Reactor/309 Building, located in the 300 Area, the deteriorated exterior insulation and weather coating on the containment dome were removed in 1999. The dome was then re-coated with a polyurea material. The insulating and roofing materials removed were suspected of containing asbestos; however, only a minor amount was found. In total, the task generated ~180 cubic meters (6,350 cubic feet) of demolition debris and 1.13 cubic meter (40 cubic feet) of asbestos waste.

During 1999, ~570 kilograms (1,250 pounds) of metallic sodium, previously drained from retired test systems into 208-liter (55-gallon) drums, was shipped offsite. Also, ~450 kilograms (1,000 pounds) of sodium-potassium alloy drained from a cooling system in 1998 was shipped offsite. Sodium residue removal operations via the water vapor-nitrogen process resumed. Three small tanks, ranging in size from 115 liters (30 gallons) to 1,150 liters (300 gallons) were cleaned or in the process of being cleaned in 1999. Concentrated sodium hydroxide produced during the cleaning process is shipped to the 300 Area Treated Effluent Disposal Facility for their use. Rinse water with pH less than 11 is sent through the process sewer line to the 300 Area Treated Effluent Disposal Facility.

2.3.7 Office of River Protection

Congress established the Office of River Protection in 1998 as a DOE Field Office reporting directly to the DOE Assistant Secretary for Environmental Management. The Office of River Protection is responsible for managing DOE's River Protection Project to store, retrieve, treat, and dispose of high-level tank waste from the Hanford Site.

2.3.7.1 Waste Tank Status

The status of the 177 waste tanks as of December 1999 was reported in HNF-EP-0182-141. This report is published monthly; the December report provided the following information:

- number of waste tanks
  - 149 single-shell tanks
  - 28 double-shell tanks
- number of tanks assumed to have leaked
  - 67 single-shell tanks
  - 0 double-shell tanks
- chronology of single-shell tank leaks
  - 1956: first tank reported as suspected of leaking (tank 241-U-104)
  - 1973: largest estimated leak reported (tank 241-T-106; 435,000 liters [115,000 gallons])
  - 1988: tanks 241-AX-102, -C-201, -C-202, -C-204, and -SX-104 confirmed as having leaked
  - 1992: latest tank (241-T-101) added to list of tanks assumed to have leaked, bringing total to 67 single-shell tanks
  - 1994: tank 241-T-111 was declared to have leaked again
- number of ferrocyanide tanks on the watch list
  - 0 (the ferrocyanide issue was closed in 1996)
- number of flammable gas tanks on the watch list
  - 19 single-shell tanks
  - 6 double-shell tanks
- number of organic tanks on the watch list
  - 2 single-shell tanks (18 tanks were removed from the watch list in December 1998)
- number of high-heat tanks on the watch list
  - 0 (one single-shell tank was removed from the watch list in December 1999).

So far, 120 single-shell tanks have been stabilized; the tank stabilization program is scheduled to be completed in 2004. At the end of 1999, 108 single-shell tanks had intrusion prevention devices completed, and 51 single-shell tanks were disconnected from the piping system and capped to avoid inadvertent liquid additions to the tanks.

The total estimated volume to date of radioactive waste leakage from single-shell tanks is 2,300,000 to 3,400,000 liters (600,000 to 900,000 gallons).

During 1999, waste was pumped from ten single-shell tanks to the double-shell tank system. Portions of waste in tanks 241-SX-104, SX-106, T-104, T-110, S-102, S-103, S-106, U-103, and U-109 (all in the 200-West Area) were removed, and the majority of waste in tank 241-C-106 (in 200-East Area) was removed.

2.3.7.2 Waste Tank Safety Issues

The Waste Tank Safety Program was established in 1990 as the focal point for identification and resolution of safety issues involving high-priority waste tanks. The tasks to resolve safety issues are

planned and implemented in the following logic sequence: 1) evaluate and define the associated safety issue, 2) identify and close any associated unreviewed safety questions, 3) mitigate any hazardous conditions to ensure safe storage of the waste, 4) monitor waste storage conditions, and 5) resolve the respective safety issues. Each of these steps has supporting tasks of some combination of monitoring, mathematical analyses, laboratory studies, and in-tank sampling or testing. The path followed depends on whether the waste requires treatment or can be stored safely by implementing strict controls.

The Safety Issue Resolution Project focuses on resolution of safety issues involving flammable gas, organic, high-heat, and criticality as described below. The tanks of concern are placed on a watch list and categorized by safety issue. By 1996, all 24 ferrocyanide tanks had been removed from the watch list, and the issue was deemed resolved by DOE and the Defense Nuclear Facilities Safety Board. In 1998, 18 tanks containing organic contaminants were removed from the watch list, leaving the 2 tanks containing organic solvent on the list. During 1999, the high-heat tank was removed from the watch list. At the end of 1999, there were 27 tanks remaining on the watch list: 25 tanks containing flammable gas and 2 tanks containing organic solvents. These tanks were identified in accordance with the *Defense Authorization Act*, Section 3137, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation" (1990).

2.3.7.3 Watch List Tanks

In early 1991, all Hanford Site high-level waste tanks were evaluated and organized into categories to ensure increased attention and monitoring. Other safety concerns, including the possibility of nuclear criticality in a waste tank, have been addressed.

Flammable Gas. The flammable gas safety issue involves the generation, retention, and potential release of flammable gases by tank waste. Twenty-five tanks have been identified and placed on the watch list. In prior years, work controls were instituted to prevent introduction of spark sources into these tanks, and evaluations were completed to ensure that installed equipment was intrinsically safe.

Conditions within tank 241-SY-101 changed in 1997, which led to a continuous rise in the waste level. In February 1998, the DOE Richland Operations Office declared an unreviewed safety question related to the waste surface level changes. The responsible contractor formed a project team to remediate the waste level rise and a project plan was issued (HNF-3824). During 1999, the increasing level of waste in tank 241-SY-101 was stopped through the transfer and dilution of the waste in this tank. Additional discussion on this issue can be found in Section 2.3.13.3, "Saltcake Dissolution."

Hydrogen monitors were installed on all 25 tanks on the flammable gas watch list; in addition, another 17 monitors were installed to gather more data on a variety of tanks and operations. These systems continuously monitor for hydrogen and have the capability to obtain grab samples for additional analyses.

The Tri-Party Agreement milestone for resolution of the safety issues surrounding tanks containing flammable gas is scheduled for September 2001.

High-Heat Tank. This safety issue was resolved in December 1999, based on the transfer of the majority of the waste in tank 241-C-106 to tank 241-AY-102. This safety issue concerned tank 241-C-106, a single-shell tank in the 200-East Area that required water additions and forced ventilation for evaporative cooling. The retrieval and transfer of 712,000 liters (188,000 gallons) of 241-C-106 waste was completed in 1999. In December 1999, DOE-Headquarters approved the closure of the high-heat issue for tank 241-C-106, and removed it from the high-heat watch list.

Organic Tanks. This safety issue involves the potential for uncontrolled exothermic reactions of

organic complexants and organic solvents present in some of the tanks. DOE identified 20 single-shell tanks for the organic watch list between 1991 and 1994. In 1998, DOE closed the organic complexant safety issue and removed 18 tanks containing organic complexant from the watch list.

The two remaining tanks on the organic watch list contain organic solvents. DOE is expected to resolve safety issues concerning these tanks per the Tri-Party Agreement milestone scheduled for September 2001.

Criticality. DOE closed the safety question regarding the potential for criticality in the high-level waste tanks in 1999. Additional analyses, stronger tank criticality prevention controls, and improved administrative procedures and training (WHC-SD-WM-SARR-003) provided the technical basis to resolve the safety issue and satisfy the related Tri Party Agreement milestone.

2.3.7.4 Vadose Zone Characterization Near Single-Shell Underground Waste Storage Tanks

Since 1995, the DOE Grand Junction Office has performed baseline spectral gamma borehole logging characterization of the vadose zone around the single-shell underground waste storage tanks at the Hanford Site. This characterization work is done in part to comply with RCRA requirements to identify contamination sources and to determine the nature and extent of the contamination from the single-shell tanks. The work also will assist with RCRA closure of the tanks.

The logging operations for the baseline characterization began in 1995 and were completed in early 1999. During 1999, boreholes surrounding tanks in the T and B tank farms, in the 200-West and 200-East Areas, respectively, were logged. The details of this work are discussed in Section 6.2.1.2, "Tank Farms Baseline Vadose Zone Characterization Project."

Preparation of tank summary data reports began in 1995. During 1999, the remaining 16 tank summary data reports for tanks in the B and T tank farms (200-East and 200-West Areas, respectively) were prepared using data acquired from boreholes logged between 1996 and 1998 (e.g., GJ-HAN-106). During 1999, a report for the A tank farm was issued. Other reports were in various stages of preparation.

During 1999, logging was repeated at selected intervals in boreholes at all 12 single-shell tank farms. A new high rate logging system was developed and used to characterize zones of high gamma flux where the older spectral gamma logging system had been ineffective. The new system provided useful data in zones with concentrations on the order of 50,000,000 pCi/g. With the completion of the final tank farm report in 2000, the baseline characterization project will begin to analyze high count rate and repeated data. These data will be combined with the results of shape factor analysis and used to modify the data required for three-dimensional visualizations. Revised visualizations will be prepared and published in addenda to the original tank farm reports.

The baseline characterization work completed in 1999 identified several areas where additional work is required to broaden knowledge of contamination conditions in the tank farm vadose zone. See Section 6.2.1.2, "Tank Farms Baseline Vadose Zone Characterization Project," for additional details regarding specific tank farms and for references to detailed reports.

2.3.7.5 Waste Immobilization

Approximately 204 million liters (54 million gallons) of radioactive and hazardous wastes, accumulated from more than 40 years of plutonium production operations, are stored in 149 underground single-shell tanks and 28 underground double-shell tanks. The River Protection Program is currently upgrading facilities to deliver waste to the planned treatment facility. Treatment will separate the

wastes into a low-radioactivity fraction and a high-radioactivity and transuranic fraction. Both fractions will be vitrified in a process that will destroy or extract organic constituents, neutralize or deactivate dangerous wastes, and immobilize toxic metals. The immobilized low-radioactivity fraction will be disposed of in a facility on the Hanford Site. The immobilized high-radioactivity fraction will be stored onsite until a geologic repository is available offsite for permanent disposal. Tri-Party Agreement milestones specify December 2028 for completion of pretreatment and immobilization of the tank wastes.

At this time, work continues on the design and permitting of the vitrification plant. DOE is seeking a new contractor to complete the design and construction of the plant and is attempting to maintain the agreed upon schedule.

2.3.8 Solid Waste Management

Solid waste may be from work on the Hanford Site or may be from sources offsite that are authorized by DOE to ship waste to the site. Treatment, storage, and disposal of solid waste takes place at a number of locations on the Hanford Site. Information about specific locations is contained in the following sections.

2.3.8.1 Central Waste Complex

Solid waste is received at the Central Waste Complex in the 200-West Area (see Figure 1.0.2) from sources of radioactive waste at the Hanford Site and any sources offsite that are authorized by DOE to ship waste to the Hanford Site for treatment, storage, and disposal. Ongoing cleanup and research and development activities on the Hanford Site, as well as remediation activities, generate the waste received at the Central Waste Complex. Offsite waste has been primarily from DOE research facilities, other DOE sites, and Department of Defense facilities. The characteristics of the waste received vary greatly, from low-level, transuranic, mixed waste, and radioactively contaminated polychlorinated biphenyls.

The planned capacity of the Central Waste Complex to store low-level mixed waste and transuranic waste is 15,540 cubic meters (20,330 cubic yards). This capacity is adequate to store the projected volumes of low-level, transuranic, mixed waste, and radioactively contaminated polychlorinated biphenyls to be generated, assuming on-schedule treatment of the stored waste. Treatment of mixed waste began in December 1999. Treatment will reduce the amount of waste in storage and make room for newly generated mixed waste. The dangerous waste designation of each container of waste is determined at its point of generation based on process knowledge of the waste placed in the container or on sample analysis if sufficient process knowledge is unavailable.

2.3.8.2 Waste Receiving and Processing Facility

During 1994, construction was started on the first major solid waste processing facility associated with cleanup of the Hanford Site. Having started operation in March 1997, the Waste Receiving and Processing Facility is staffed to analyze, characterize, and prepare drums and boxes of wastes for disposal. The 4,800-square meter (52,000-square foot) facility is near the Central Waste Complex in the 200-West Area (see Figure 1.0.2). The facility is designed to process ~6,800 drums and 70 boxes of waste annually for 30 years.

Waste destined for the Waste Receiving and Processing Facility include Hanford's legacy waste as well as newly generated waste from current and future site cleanup activities. The waste consists primarily of clothing, gloves, face masks, and small

tools suspected of being contaminated with plutonium. Waste containers might also contain other radioactive materials and hazardous components. Processed waste that qualifies as low-level waste and meets disposal requirements will be buried directly at the Hanford Site. Low-level waste not meeting burial requirements will be treated in the facility until it meets the requirements or will be prepared for future treatment at other onsite or offsite treatment, storage, and disposal facilities. Waste designated at the facility to be transuranic will be certified and packaged for shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico for permanent storage. Materials that require further processing to meet disposal criteria will be retained at the Hanford Site, pending treatment.

2.3.8.3 Radioactive Mixed Waste Disposal Facilities

The radioactive mixed waste disposal facilities at the Hanford Site are the first in DOE's complex for the disposal of radioactive mixed wastes. These facilities are located in the 218-W-5 low-level waste burial ground in the 200-West Area and are designated as trenches 31 and 34. Trench 34 began to operate in the disposal mode during September 1999. Prior to this, trenches 31 and 34 were operating in the storage mode. Trench 31 will continue to operate in the storage mode when needed to accommodate large items awaiting disposal into trench 34. Currently, no waste is stored in trench 31. The trenches are rectangular landfills, with approximate base dimensions of 76 by 30 meters (250 by 100 feet). The bottoms of the excavations slope slightly, giving a variable depth of 9 to 12 meters (30 to 40 feet).

These trenches comply with RCRA requirements by having double liners and leachate collection and removal systems. The bottom and sides of the facilities are covered with a layer of soil (1 meter [3 feet]) to protect the liner system during fill operations. There is a recessed section at the end of each excavation that houses a sump for leachate collection. Access to the bottom of each trench is provided by ramps along the perimeter walls.

2.3.8.4 T Plant Complex

The function of the T Plant complex in the 200-West Area (see Figure 1.0.2) is to provide waste treatment and storage and decontamination services for the Hanford Site. The T Plant complex currently operates under interim status. T Plant complex waste handling activities in 1999 included the following:

- performing content verification of wastes being shipped to solid waste facilities for storage or disposal
- repackaging and/or sampling waste to meet solid waste acceptance criteria or to determine acceptability of waste for treatment
- treating dangerous and mixed wastes to meet RCRA requirements for land disposal
- decontaminating equipment to allow for reuse or disposal as waste
- storing 27 metric tons (30 tons) of spent reactor fuel (from Shippingport, Pennsylvania) in a water basin.

2.3.8.5 Radioactive Mixed Waste Treatment and Disposal

During 1999, 26 cubic meters (34 cubic yards) of DOE mixed waste were treated and/or disposed of. The waste materials were obtained from a number of projects and included the following:

- 25 cubic meters (~120 - 55-gallon drums) of soil originating from various single-shell and double-shell tank farms at the Hanford Site were disposed into the low-level burial grounds. It was determined that the soil did not contain hazardous constituents (i.e., a "Contained-In"

determination), which was subsequently approved by the Washington State Department of Ecology.

- 1 cubic meter (5 - 55-gallon drums) of mixed low-level waste was disposed into the Radioactive Mixed Waste Disposal facility (Trench 218-W-34). Waste was designated with State-Only waste codes and met the disposal requirements specified in the Hanford Site Solid Waste Acceptance Criteria.

2.3.8.6 Radioactive Mixed Waste Treatment Contracts

In November 1995, DOE awarded a contract to Allied Technology Group, Inc., Richland, Washington, for thermal treatment of Hanford's mixed waste in accordance with RCRA and the *Toxic Substances Control Act*. The contract provides for treating up to 5,135 cubic meters (6,715 cubic yards) of mixed waste over 5 years with five 1-year renewal options. Waste processing is scheduled to begin in fiscal year 2001.

During 1997, a competitive procurement was conducted for the processing of mixed waste requiring nonthermal treatment in accordance with RCRA. The resulting contract provides for treatment of up to 1,860 cubic meters (2,432 cubic yards) of waste. The contract, which was also awarded to Allied Technology Group, Inc., has a 1-year base period (fiscal year 2000) with two extension options (for fiscal years 2000-2001 and 2001-2002, respectively). During 1999, Allied Technology Group, Inc. was granted their RCRA/*Toxic Substance Control Act* operating permit from Washington State Department of Ecology/EPA. Construction on their treatment facility began in July 1999, and treatment was initiated on December 22, 1999.

2.3.8.7 Navy Reactor Compartments

Nine disposal packages containing defueled United States Navy reactor compartments were received and placed in Trench 94 in the 200-East Area during 1999. Three reactor compartments were from submarines and six were from cruisers. This brings the total number of reactor compartments received to 86. All reactor compartments shipped to the Hanford Site for disposal have originated from decommissioned nuclear-powered submarines or cruisers.

Washington State Department of Ecology regulates the disposal of reactor compartments as dangerous waste because lead is used as shielding. The reactor compartments are also managed as mixed waste because of their radioactivity.

2.3.9 Liquid Effluent Treatment

Hazardous and radioactive liquid waste is no longer discharged directly to the environment at the Hanford Site. Liquid effluents are managed in treatment, storage, and disposal facilities in compliance with RCRA and state regulations.

2.3.9.1 242-A Evaporator

Available storage space to support remediation of tank waste and cleanup of the Hanford Site is limited in the double-shell tanks. The 242-A Evaporator in the 200-East Area (see Figure 1.0.2) processes double-shell tank waste into a concentrate (that is returned to the tanks) and a process condensate stream. One campaign was conducted at the 242-A evaporator in 1999. The run treated 3.83 million liters (1,012,000 gallons) of tank waste to produce 3.56 million liters (940,000 gallons) of aqueous waste that were sent to the Liquid Effluent Retention Facility (discussed in Section 2.3.9.2). One 242-A evaporator campaign is planned for 2000, and two campaigns are planned for 2001.

Effluent treatment and disposal capabilities are available to support the continued operation of the

242-A evaporator. The 200 Area Effluent Treatment Facility near the 200-East Area was constructed to treat the process condensate. Process condensate is temporarily stored in the Liquid Effluent Retention Facility while awaiting treatment in the 200 Areas Effluent Treatment Facility. Cooling water and nonradioactive steam condensate from the evaporator are discharged to the 200 Areas Treated Effluent Disposal Facility.

2.3.9.2 Liquid Effluent Retention Facility

This facility consists of three RCRA-compliant surface impoundments for storing and treating process condensate from the 242-A evaporator and other aqueous wastes. The facility treats waste by equalizing the flow and adjusting the pH of the feed to the 200 Areas Effluent Treatment Facility. The maximum capacity of the Liquid Effluent Retention Facility is 89 million liters (23.4 million gallons). The basins are constructed of two, flexible, high-density, polyethylene membrane liners. A system is provided to detect, collect, and remove leachate from between the primary and secondary liners. Beneath the secondary liner is a soil/bentonite barrier should the primary and secondary liners fail. Each basin has a mechanically tensioned floating membrane cover constructed of very low-density polyethylene to keep out unwanted material and to minimize evaporation of the basin contents. The facility began operation in April 1994 and receives aqueous waste from both RCRA- and CERCLA-regulated cleanup activities. Approximately 38.8 million liters (10.3 million gallons) of aqueous waste were stored in the basins at the end of 1999.

2.3.9.3 200 Areas Effluent Treatment Facility

This facility provides treatment and storage for hazardous and radioactive aqueous waste. The treated effluent is stored in verification tanks, sampled and analyzed, and discharged to the 616-A crib (also called the State-Approved Land Disposal Site). The treatment process constitutes best available technology, and includes pH adjustment, filtration, ultraviolet light/peroxide destruction of organic compounds, reverse osmosis to remove dissolved solids, and ion exchange to remove the last traces of contaminants. The facility began operation in December 1995. Treatment capacity of the facility is 570 liters per minute (150 gallons per minute). Approximately 81.5 million liters (21.5 million gallons) of aqueous waste were treated in 1999.

The treated effluent is sampled to verify that the radioactive and hazardous waste constituents have been reduced to regulatory levels; then discharged via a dedicated pipeline to the State-Approved Land Disposal Site. The disposal site is located north of the 200-West Area and is an underground drain field. The percolation rates for the field have been established by site testing and evaluation of soil characteristics. Tritium in the liquid effluent cannot be practically removed, and the location of the disposal site maximizes the time for migration to the Columbia River to allow for radioactive decay. The disposal site is permitted under WAC 173-216. The discharge permit requires monitoring of the groundwater and the treated effluent to ensure that levels for certain constituents are not exceeded. Constituent level limits were not exceeded in 1999. The discharge permit for the 200 Areas Effluent Treatment Facility is scheduled to be renewed in 2000.

Secondary waste from treating aqueous waste is concentrated, dried, and packaged in 208-liter (55-gallon) drums. The secondary waste from treating regulated aqueous waste is transferred to the Central Waste Complex for subsequent treatment (if needed to meet land disposal restriction treatment standards) and disposal in the radioactive mixed waste disposal facility, Trench 34, in the 200-West Area. The secondary waste from treating CERCLA-regulated aqueous waste is disposed of in the Environmental Restoration Disposal Facility near the 200-West Area.

2.3.9.4 200 Areas Treated Effluent Disposal Facility

This disposal facility is a collection and disposal system for non-RCRA-permitted waste that has been treated using "best available technology/ all known and reasonable treatment." Implementation of regulatory "best available technology/all known and reasonable treatment" is the responsibility of the generating facilities. There are 14 waste generating facilities in the 200 Areas that send waste to the 200 Areas Treated Effluent Disposal Facility (see Figure 1.0.2).

This facility began operation in April 1995 and has a capacity of 12,900 liters per minute (3,400 gallons per minute). Approximately 534 million liters (141 million gallons) of effluent were discharged in 1999. The effluent is discharged to two 2-hectare (5-acre) disposal ponds located east of the 200-East Area. The discharge permit requires monitoring of the effluent and the groundwater to ensure that concentrations for certain constituents are not exceeded. The discharge permit for the 200 Areas Treated Effluent Disposal Facility is scheduled to be renewed in 2000.

2.3.10 Revegetation and Mitigation Planning

Bechtel Hanford, Inc. planted 77 hectares (190 acres) of sagebrush in several small areas on the Fitzner/Eberhardt Arid Lands Ecology Reserve to mitigate the effects from construction of Cells 3 and 4 of the Environmental Restoration Disposal Facility in 1998. Representative plots of each area were selected and sagebrush survival was estimated. Low survival was noted at two of the plots. In December 1999, an additional 250 sagebrush seedlings were planted to compensate for the low survival rates.

In 1997, bitterbrush plants were salvaged from the perimeter of the 618-4 burial ground (600 Area) and transplanted to the area surrounding the burial ground. An additional 293 container grown sagebrush seedlings were planted adjacent to the bitterbrush to make up for the loss of mature shrubs during remediation of the burial ground. Examination of the plantings showed that all the bitterbrush and 46% of the planted sagebrush died. In November 1999, the dead sagebrush plants were replaced with new sagebrush seedlings. In addition to planting 126 sagebrush seedlings, 50 bitterbrush seedlings were planted east of the 618-4 burial ground. All bitterbrush plants were protected with biodegradable plastic mesh tubes that were staked into the ground to prevent browsing by deer.

A second bat gate was installed at the DR Reactor building allowing access to both noncontaminated process water tunnels. These tunnels provide habitat for a Washington State protected bat species that has been living in the reactor building (Washington State Department of Fish and Wildlife 1996). The bat gates were constructed to allow bats into the tunnels while preventing human intrusion. An existing structure at the DR Reactor building was used to preserve an important maternity roost that bats have used for many years.

Revegetation of 100-B,C liquid effluent disposal sites 116-C-5, 116-B-1, and 116-B-11 was completed as part of the CERCLA Remedial Action Project for the 100-B,C Area. The remediated sites, 5.27 hectares (13 acres) were replanted with Sandberg's bluegrass, needle-and-thread grass, sagebrush, snow buckwheat, Carey's Balsamroot, yarrow, and small amounts of cushion fleabane and Piper's daisy.

2.3.11 Environmental Restoration Project

In 1994, DOE selected an environmental restoration contractor to oversee the restoration of the Hanford Site. The Environmental Restoration Project includes characterization and remediation of contaminated soil and groundwater, decontamination and decommissioning of facilities, surveillance and maintenance of inactive waste sites, transition of facilities into the surveillance and maintenance program, and sitewide vadose zone/groundwater integration.

2.3.11.1 Environmental Restoration Disposal Facility

The Environmental Restoration Disposal Facility is located near the 200-West Area (see Figure 1.0.2). The facility began operations in July of 1996 and was designed to serve as the central disposal site for contaminated waste removed during cleanup operations conducted under CERCLA on the Hanford Site. In order to provide a protective barrier, the 918,000-cubic meter (1,200,000-cubic yard) earthen facility was constructed with double liners and a leachate collection system. In 1999, the Environmental Restoration Disposal Facility was expanded to provide additional storage space for contaminated materials from ongoing remediation work. The expansion more than doubled the capacity of the original two cells. Cleanup materials relocated to the facility include soil, rubble, or other materials (excluding liquids) contaminated with hazardous, low-level radioactive or mixed (combined hazardous chemical radioactive) wastes. As of early calendar year 2000, the facility had received 1,975,000 metric tons (2,177,000 tons) of contaminated soil and other waste.

2.3.11.2 Waste Site Remediation

Full-scale remediation of waste sites began in the 100 Areas in 1996. Remediation continued through 1999 at several liquid waste disposal sites in the 100-B,C and 100-D/DR Areas. In March 1999, remediation work began in the 100-HR Area.

- In the 100-B,C Area, 51,700 metric tons (57,000 tons) of soil were removed in 1999 from 13 different waste sites. Through December 1999, 621,100 metric tons (685,000 tons) of contaminated soil have been removed and shipped to the Environmental Restoration Disposal Facility. Backfill activities were completed at five waste sites.
- In the 100-DR Area, 112,200 metric tons (124,000 tons) of soil were removed from 15 waste sites. The removal of effluent pipelines at 100-DR was the first significant removal of pipe at the reactors. Through December 1999, 549,000 metric tons (610,000 tons) of contaminated soil was removed and shipped to the Environmental Restoration Disposal Facility.
- In the 100-HR Area, 200,000 metric tons (224,000 tons) of soil were removed from the six waste sites and around effluent pipelines. The startup of remedial actions at 100-HR completed Tri-Party Agreement milestone M-16-26A.

Remediation work at the 300-FF-1 Operable Unit began in the 300 Area in 1997. Historically, both chemical and radiological materials were disposed of at the 300-FF-1 waste sites. In 1999, remediation operations excavated nearly 214,000 metric tons (236,000 tons) of contaminated soils and debris that were shipped to the Environmental Restoration Disposal Facility. Over 388,754 metric tons (428,000 tons) have been removed to date. Remediation (excavation) of the 316-2 North Process Pond (300 Area) was completed in 1999, remediation (excavation) continued in the 316-1 South Process Pond, and in December of 1999, remediation in 300 Area Landfills 1A (300-49) and 1B (300-50) was initiated.

A Record of Decision (EPA 1999a) was issued for the 100 Areas remaining sites in 1999. It specified a cleanup remedy, remove/treat/dispose, for contaminated soil, structures, and debris at the remaining sites. The cleanup remedy is the method applied to 100 Areas Record of Decision sites and is consistent with cleanup actions that are currently being conducted within the 100 Areas.

The Record of Decision for remaining sites includes ~300 waste sites that were not previously addressed in the 1995 100 Areas Record of Decision or the 1997 amendment to the 100 Areas Record of Decision (100 Areas solid waste burial sites and waste sites at 100-N Area also not included). Issuance of the remaining sites Record of Decision leaves only one outstanding 100 Areas Record of Decision for the solid waste burial sites, which is expected in 2000.

In 1999, DOE began design of remedial actions for the remaining sites. These actions are expected to be completed in 2000. A Record of Decision (EPA 1999b) for remediation of ~80 waste sites and groundwater at the 100-N Area was also issued in 1999. The Record of Decision specified remove/treat/dispose for remediation of the waste sites and continuation of pump-and-treat operations for remediation of groundwater. Design of remedial activities began for 100-N treatment, storage, and disposal units in 1999 in anticipation of a Record of Decision for the treatment, storage, and disposal units in 2000.

2.3.11.3 Decommissioning Project

Decontamination and decommissioning continued in 1999 in the 100-DR and 100-F Areas. During the year, ancillary facilities that supported the DR and F reactors were removed and disposed. The activities support the interim safe storage of the reactor buildings. Other decontamination and decommissioning work was completed during the year that reduced the skyline in both 100-D/DR Areas and 100-F Area. A four-story laboratory (108-F) located near the 105-F reactor was decontaminated and demolished. Two, 200-foot exhaust stacks were demolished by explosive demolition at the 100-D/DR Area. The stack rubble was packaged and shipped to the 200 Area Environmental Restoration Disposal Facility for final disposal. Decontamination and decommissioning work continued at the 233-S laboratory building located in the 200-West Area. The facility poses special challenges to workers and work methods due to high levels of radiation.

2.3.11.4 Surveillance/ Maintenance and Transition Project

This project performs surveillance and maintenance of inactive facilities until final disposition. The project also provides for the transition of facilities and waste sites into the Environmental Restoration Program after deactivation is complete. The project includes the Radiation Area Remedial Action Program, which is responsible for the surveillance, maintenance, and decontamination or stabilization of 837 inactive waste sites. These include cribs, ponds, ditches, trenches, unplanned release sites, and burial grounds. These sites are maintained by performing periodic surveillances, radiation surveys, and herbicide applications and by initiating timely responses to identified problems. The overall objective of this project is to maintain these sites in a safe and stable configuration until final remediation strategies are identified and implemented. The main focus of this objective is to prevent the contaminants contained in these sites from spreading in the environment. This project also analyzed the final status/ condition of the canyon facilities (i.e., large concrete structures formerly used in Hanford Site production missions) that the project currently oversees and those that are coming to the project through facility transition activities. The canyon disposition initiative is evaluating the potential to use the canyon facilities as waste disposal units, compared to standard decontamination and decommissioning of the facilities. The canyon disposition initiative has a potential to achieve a saving of $1 billion compared to removal of the facilities.

2.3.12 Groundwater/Vadose Zone Integration Project

The Groundwater/Vadose Zone Integration Project brings together all activities that effect Hanford's subsurface, and ultimately, the Columbia River. Many of these activities are part of multiple cleanup projects that report to different managers and contractors.

A focus of the Groundwater/Vadose Zone Integration Project involves preparation of a cumulative impact assessment of Hanford Site radioactive and hazardous contaminants that have, or may, affect the uses and users of the Columbia River. The project continues to work on the design of a system assessment capability to meet the needs identified in the *Columbia River Comprehensive Impact Assessment Part II* report (DOE/RL-96-16). To be successful, the project must

- adopt a sitewide approach to project planning, funding, and data and information management to support cleanup decisions
- ensure that management attention is maintained on the subsurface and river resources
- be recognized for technical and scientific excellence in all products
- establish and ensure effective two-way communication with diverse project participants.

2.3.12.1 Groundwater Restoration

Chromium. Groundwater contaminated with chromium underlies portions of the 100-D, 100-H, and 100-K Areas (the 100-HR-3 and 100-KR-4 Operable Units) and is of concern because of its potential to impact the Columbia River ecosystem. Low levels of chromium are toxic to aquatic organisms, particularly those that use the riverbed sediment as habitat (DOE/RL-94-102, DOE/RL-94-113). The relevant standard for protection of freshwater aquatic life is 10 mg/L of chromium (WAC 173-201A). Chromium concentrations exceeding 600 mg/L have been measured in the pore-water sediments of the Columbia River (BHI-00778). In 1994, a groundwater extraction system was installed in the 100-D Area to test chromium removal from groundwater using ion exchange technology. Following the approval of the record of decision in 1996 (EPA 1996), full-scale pump-and-treat systems were constructed in the 100-D, 100-H, and 100-K Areas. The objective of the pump-and-treat systems is to prevent chromium contamination in the groundwater from reaching the Columbia River.

In 1999, the total amount of water treated for the 100-D and 100-H pump-and-treat systems was 251 million liters (66.3 million gallons), with the removal of 20.4 kilograms (45.0 pounds) of chromium. To date, more than 652 million liters (172 million gallons) of groundwater have been treated, with 73 kilograms (160.9 pounds) of chromium removed (DOE/RL 2000-14, Rev. 0). Treated groundwater is reinjected into the aquifer upgradient from the 100-H Area extraction wells since both sites use the same treatment system.

In 1999, the 100-KR pump-and-treat system treated 310 million liters (81.9 million gallons) of groundwater. During the process, 38.2 kilograms (84.2 pounds) of chromium were removed. Total chromium removed since operations began is 79 kilograms (174.2 pounds) through treatment of 611 million liters (161.4 million gallons) of water. Treated groundwater is reinjected into the aquifer upgradient from the 100-KR-4 extraction wells.

To further evaluate chromium and other groundwater contamination that might enter the Columbia River, 178 aquifer sample tubes were installed in 1997 along and parallel to the Columbia River shoreline. The distance between the sample tubes was ~610 meters (2,000 feet), except in known chromium plumes, where this was reduced to

~305 meters (1,000 feet). Sample tubes are constructed of 0.6 centimeter (0.25 inch) inner-diameter polyethylene tubing with a screen at the bottom that is placed anywhere from 0.9 to 9 meters (3 to 30 feet) below ground surface. Sample tube installations begin near the 100-B,C Area and continue downstream ~40 kilometers (25 miles) to near the Old Hanford Townsite.

In the fall of 1999, samples were collected from 29 sample tube locations. These samples were analyzed for chromium, nitrate, sulfate, tritium, strontium-90, total uranium, gross beta, and carbon-14. The results are being used to characterize near Columbia River groundwater/river water in support of remediation operations, monitoring objectives, and other environmental programs. Sample tube data provide site specific information on the distribution of chromium that enters the river at locations near sensitive ecological receptors (e.g., salmon spawning areas).

Pore water and aquifer sample tube data collected in 1995 were instrumental in finding chromium contaminated groundwater at the 100-D Area where it previously was not identified (BHI-00778). A technology called In Situ Redox Manipulation was selected to remediate this high-concentration area beginning in fiscal year 2000. This technology using a chemical barrier was tested and successfully applied during a chromium treatability test in the 100-D Area from 1997 to 1999. The barrier will be constructed to intercept and neutralize chromium contaminated groundwater moving from the aquifer to the Columbia River. The current pump-and-treat systems will also continue to operate.

Strontium-90. The 100-NR-2 (N Springs) pump-and-treat system began operations in 1995 north of the N Reactor complex and was designed to reduce the flux of strontium-90 to the Columbia River. The pump-and-treat system operates extraction wells to maintain hydraulic capture. Groundwater is pumped into a treatment system to remove the strontium-90 contamination, with treated water reinjected upgradient into the aquifer. The system was upgraded in 1996 and has continued to operate through 1999. About 114 million liters (30.1 million gallons) were processed in fiscal year 1999. During that period, 0.2 curie of strontium were removed from the groundwater. Over 422.2 million liters (111.5 million gallons) have been processed since the system began operation, removing 0.7 curie of strontium.

Carbon Tetrachloride. The carbon tetrachloride plume in the 200-West Area (underlying the 200-ZP-1 Operable Unit) covers over 11 square kilometers (4.2 square miles). The 200-ZP-1 pump-and-treat system has operated since 1997. In 1999, 339.9 million liters (89.8 million gallons) of groundwater were treated, removing over 1,287 kilograms (2,837 pounds) of carbon tetrachloride. A total of about 954.8 million liters (252.3 million gallons) have been processed since startup removing 3,386.5 kilograms (7,466 pounds) of carbon tetrachloride. An Innovative Technology Remediation Demonstration project was initiated in 1999 to evaluate ways to accelerate and enhance the removal of carbon tetrachloride, and to identify characterization tools that could be used to define the full extent of the plume beneath the ground surface.

Uranium, Technetium-99, Carbon Tetrachloride, and Nitrates. Treatment of the groundwater plume underlying the 200-UP-1 Operable Unit in the 200-West Area continued throughout 1999. The contaminant plume contains uranium, technetium-99, carbon tetrachloride, and nitrate. A pump-and-treat system has operated since 1994 to contain the high concentration area of the uranium and technetium-99 plume. During early operations, groundwater was treated using ion-exchange resin to remove the uranium and technetium-99, and granular activated carbon to remove carbon tetrachloride. Since 1997, contaminated groundwater is transported to Basins 43 at the 200 Areas Effluent Treatment Facility. Sophisticated treatment technology removes all four contaminants.

Treated groundwater is then discharged north of the 200-West Area at the State-Approved Land Disposal Site.

The pump-and-treat system operated continually during the year, except for a period of shutdown in December 1999 because of concerns about possible computer problems at the beginning of 2000. The single extraction well was used to pump 93.5 million liters (24.7 million gallons) of groundwater, which were treated to remove 7.8 grams (0.0172 pound) of technetium-99, 20.7 kilograms (45.6 pounds) of uranium, 2.0 kilograms (4.4 pounds) of carbon tetrachloride, and 4,859 kilograms (10,712 pounds) of nitrate. The pump-and-treat operation made significant progress toward reducing technetium-99 concentrations to below required cleanup concentration levels, but less progress was made with uranium (DOE/RL-99-79).

2.3.12.2 Vadose Zone Remediation

Soil vapor extraction systems designed to remove carbon tetrachloride vapor from the vadose zone beneath the 200-West Area began operating in 1992 and continued through 1999. Soil vapor extraction has been conducted in the vicinity of three historical carbon tetrachloride disposal sites: the 216-Z 1A tile field, the 216-Z-9 trench, and the 216-Z-18 crib. Soil vapor is pumped through granular activated carbon, which absorbs carbon tetrachloride. The granular activated carbon is then shipped offsite for treatment. Since 1993, carbon tetrachloride concentrations have been monitored using infrared photoacoustic spectrometers at soil vapor extraction inlets, vent stacks, individual wells, and soil vapor probes.

The magnitude and rate of carbon tetrachloride rebound (i.e., a buildup of carbon tetrachloride vapor in the soil following cessation of extraction activities) was studied in 1997. Data indicated that carbon tetrachloride concentrations increased when a shutdown period followed continuous extraction operations. This resulted in a modification to the operating strategy at the three extraction sites. The modification was to operate only the 14.2-cubic meters per minute (500-cubic feet per minute) flow rate system. The 28.3- and 42.5-cubic meters per minute (1,000- and 1,500-cubic feet per minute) flow rate systems were placed on standby. The 14.2-cubic meters per minute (500-cubic feet per minute) flow rate system is now moved periodically among the well fields extracting vapor from beneath the 216-Z-1A tile field, 216-Z-9 trench, 216-Z-12 crib, and 216-Z-18 crib. The system was shutdown for 6 months in 1999 to let carbon tetrachloride concentrations at the extraction sites rebound. In 1999, the soil vapor extraction system removed 827 kilograms (1,823 pounds) of carbon tetrachloride from the vadose zone in the 200-West Area. Since operations began, soil vapor extraction has removed 76,460 kilograms (168,560 pounds) of carbon tetrachloride from the vadose zone.

2.3.12.3 Vadose Zone Characterization in the 200 Areas

In 1999, characterization data were collected at 2 of the 23 operable units located within the 200 Areas. This was the first characterization to be conducted for the process-based waste site operable units defined in the 200 Areas Remedial Investigation/Feasibility Study Implementation Plan (DOE/RL-98-28).

200-CS-1 Operable Unit. A characterization borehole (B8817) was drilled to the groundwater near the former 216-S-10 pond and ditch, 200-West Area, during late November and early December 1999. The borehole was completed as a RCRA groundwater monitoring well (299-W26-13) as part of an integration effort with the RCRA Groundwater Monitoring Program. The pond is one of four representative sites for which data will be collected as specified in the 200-CS-1 Operable Unit Remedial Investigation/Feasibility Study Work Plan and RCRA

Treatment, Storage, and Disposal Unit Sampling Plan (DOE/RL-99-44). The borehole was drilled to obtain characterization information to support the remedial investigation and feasibility study for the operable unit. The former 216-S-10 pond and ditch routinely received large quantities of nondangerous, low-level radioactive liquid effluent from the Reduction-Oxidation facility chemical sewer and the Chemical Engineering Laboratory within the Reduction-Oxidation Plant.

A total of ten vadose zone soil samples including three quality control samples were collected and analyzed for various radionuclides, metals, inorganic compounds, volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, and diesel. In addition, three soil physical property samples were collected (one within each of the three geological units) and analyzed for moisture content, particle size distribution, and bulk density. Geophysical surveys of the borehole B8817 included both spectral gamma logging and neutron-neutron logging. The data collected will be reported in a borehole summary report scheduled for completion in 2000.

200-CW-1 Operable Unit. A characterization borehole (B8758) was drilled in the former 216-B-3 main pond in the 200-East Area. The borehole was drilled to groundwater to support vadose zone sample collection for the 200-CW-1 Operable Unit remedial investigation/feasibility study process. Drilling continued on the borehole and it was ultimately completed as a RCRA groundwater monitoring well (299-43-44) as part of an integration effort with the RCRA Groundwater Monitoring Program. A characterization borehole (B8757) was drilled in the former 216-A-25 Gable Mountain Pond near the 200-East Area. The borehole was drilled to 11 meters (37 feet) below the ground surface, several feet into the basalt at that location. Soil samples were collected and the borehole was backfilled. Geophysical surveys of both boreholes were conducted using spectral gamma and neutron-neutron logging tools. Physical property samples were collected from the boreholes.

A total of 29 test pits, used to collect soil samples at various depths below the surface, were constructed at four representative sites within the operable unit. Sixteen test pits were constructed at the former 216-A-25 Gable Mountain Pond; five at the former 216-B-3 main pond; five at the 216-B-3-3 ditch; and three at the former 216-B-2-2 ditch. Soil samples were collected from the pond or ditch bottom to a maximum of 8 meters (25 feet) below ground surface in each of the test pits. A total of 203 characterization samples were collected from the representative sites and analyzed for varying constituents including radionuclides, metals, inorganic compounds, volatile organic compounds, semivolatile organic compounds, polychlorinated biphenyls, and diesel fuel.

The data collected will be reported in a borehole and test pit summary report and a remedial investigation report for the operable unit; both reports are scheduled to be completed in 2000.

2.3.13 Research and Technology Development

In 1994, the Tanks Focus Area was created by DOE's Office of Environmental Management to integrate tank waste remediation across the DOE complex. The Tanks Focus Area leverages resources from other DOE programs, industry, and university partners to deliver technical solutions to five DOE sites: Idaho National Engineering and Environmental Laboratory; Hanford Site, Oak Ridge Reservation, Savannah River Site, and the West Valley Demonstration Project.

In support of DOE's newly formed Office of River Protection and its River Protection Project (previously known as the Tank Waste Remediation System under the auspices of DOE's Richland Operations Office), the Tanks Focus Area addressed a

number of high priority issues in 1999. Many of these activities contribute to improved tank farm operations at the Hanford Site, while others directly support future waste retrieval, treatment, and tank closure.

2.3.13.1 Corrosion Control

Since 1993, the Tanks Focus Area has assisted the Hanford Site in developing and deploying electrochemical noise corrosion probes to guard against tank wall corrosion and reduce waste volumes requiring downstream processing. Each new probe (four are now installed) improved upon the previous version. In 1999, the latest "multi-function" corrosion probe, including a complete electronics package, was successfully tested and delivered to the tank farms for installation in double-shell tank 241-AN-105. Information gathered by the probes will be integrated in a central monitoring station for real-time comparative data analysis. Replacement of current chemistry monitoring techniques with corrosion monitoring equipment is being considered.

2.3.13.2 Technical Alternatives for Hanford Tank Waste Privatization

A team of national experts was convened to identify technical improvements and alternative processes for the Hanford Site high-level waste treatment program. Specifically, the team evaluated the technical risks and identified technical alternatives for the high-risk portions of current Hanford Site tank waste treatment. The team was also asked to recommend preferred technical alternatives and a prioritized list of new work required to implement the alternatives. The results of this evaluation were published in a report, "Technical Alternatives to Reduce Risk in the Hanford Tank Waste Remediation System Phase I Privatization Project" (DOE/EM-0493).

2.3.13.3 Saltcake Dissolution

Possible mitigation measures for the saltcake crust growth in tank 241-SY-101 was investigated by running the Environmental Simulation Program model. Results of these scenarios were presented at a workshop to investigate and evaluate various options for mitigating and remediating the crust layer in waste tanks. The final recommendation for transferring waste from tank 241-SY-101 to tank 241-SY-102 was a four-step process, with decision points following each step to assess the success of the previous step.

The transfer and dilution strategy proved successful. In December 1999 and January 2000, tank farm operations staff transferred approximately 1,200,000 liters (317,000 gallons) of original waste from tank 241-SY-101. After the waste transfers were completed, the addition of dilution water to tank 241-SY-101 began. In-tank cameras and level detectors indicated no further evidence of the troublesome thick saltcake layer. The Office of River Protection plans to continue with transfers and water dilutions to ensure that the waste will not revert to crust growth and gas retention.

2.3.13.4 Recommendations on Operating Regimes for Cross-Site Pipeline Transfers

A new cross-site transfer line was constructed at the Hanford Site to manage the volume of tank farm waste and the future delivery of waste to a treatment facility. Previous waste transfer operations have experienced problems with pipeline blockage. In preparation for use of the new transfer line, viscosity tests were performed to determine the key chemicals that can interfere with waste transfer. The tests indicated that phosphate concentration, ionic strength, and temperature must be controlled to prevent chemical plugs during waste transfers. Further experiments are under way to determine safe transfer conditions based on these results.

2.3.13.5 Feasibility Testing for the Fluidic Sampler

A new sampling system that uses power fluidics technology to collect and transfer tank waste samples is being designed and tested. Consistent with RCRA sampling requirements, the modified sample collection method uses an upright (as opposed to inverted) sample bottle with a septum and a needle, thereby achieving the RCRA-required zero headspace in the bottle. In 1999, Phase I feasibility tests were successfully conducted on the new sampler to 1) demonstrate that representative samples could be obtained, 2) optimize the process to minimize bottle-filling time, and 3) demonstrate recovery from a plugged condition.